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ABSTRACT

This manual was developed to familiarize teachers with the study of the impacts of technology and to supply resource materials so that teachers can develop a unit of instruction on the topic or include the subject in existing units of instruction. The first part of the manual contains eight learning activity packets (LAPs). Each LAP consists of prerequisites, objectives, competencies, information and discussion, and suggested activities. The LAPs cover the following topics: (1) how and why technology has had an impact on people's lives; (2) types of impacts; (3) environmental impacts; (4) technical impacts; (5) financial impacts; (6) social impacts; (7) technology assessment; and (8) terminology. The second part of the manual contains appendixes listing suggested texts, filmstrips, videos, films, and resource agencies with addresses. (KC)

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IMPACT of Technology

Jerry P. Balistreri

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Introduction

The Technology Education profession has, by definition, an obligation to address the topic, "Impacts of Technology." This obligation is noted in the definition ITEA has provided in the document *Technology Education—A Perspective on Implementation*:

> Technology Education: A comprehensive action-based educational program concerned with technical means, their evolution, utilization, and significance; with industry, its organization, personnel, systems, techniques, resources, and products; and their social/cultural impact. (p. 25)

In addition to the definition stated above, there has been a call for the study of technology and its impacts in several national reform reports as evidenced by the following from *High Schools: A Report on Secondary Education in America* by Ernest L. Boyer:

> Technology: All students should study technology: The History of Man's Use of Tools, how science and technology have been joined, and the ethical and social issues technology has raised.

Despite these reasons for the study of impacts of technology, there are yet other reasons and in the opinion of this author, are the most important. Those reasons are:

- Technologies are penetrating every aspect of our lives, homes, factories and offices.
- Technology is radically transforming a host of occupations.
- Absolutely no one can escape the impact(s) these changes have on our society and lives.
- Awareness of the ethical, moral, legal and governmental aspects of technology and its impacts are needed to develop a truly technologically literate person.

The study of impacts of technology in the secondary schools, and the technology education classroom particularly, has been minimal at best. Reasons for this lack of study are many, however, the two most prominent reasons are:

- The lack of understanding of what the study of impacts may involve.
- The lack of resource materials for the junior high school/senior high school level to have this topic become a viable subject to study in technology education programs across the United States.

Since a great number of technology education teachers, at all levels, have not had the opportunity to gain knowledge of impacts of technology at the pre-service level, this manual was developed.

It is the intent of this manual to have the reader (teachers) become familiar with what the study of Impacts of Technology is, and supply enough resource materials so that one could develop a unit of instruction on the topic of "Impacts of Technology" or include the subject in existing units of instruction. The material contained in this manual will be easy to understand material for the absolute novice.

Jerry Balistreri

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LEARNING ACTIVITY PACKET **1**

How and Why Technology Has Impacted our Lives

Prerequisite LAP(s): None

LAP Objective
To understand how and why technology has impacted our lives.

LAP Competencies
1. To realize that technology surrounds us daily.
2. To realize we are constantly being affected as a result of technology.
3. To realize change is inevitable.

For as long as humans have been in existence and in all likelihood as long as they will be in existence, change will continue to be a dominant force in our lives. The only real question as earthlings is at what rate and in what direction will this change lead us. (Kline, S.)

One of the major driving forces behind this rapid change in technology has been economic pressures. Economic pressure to reduce the cost of standard devices, training, the economic incentive provided by the market for new devices, and the imagination of designers all contribute to the move toward refined equipment, methods, and new products. In addition, more people than ever before are working on research and development throughout the world. The result is that, in the last few years, new developments have begun to arrive faster than predicted in many areas of technology. Thus the whole concept of even developing technologies has impacted our society by the need for more people trained in research and development.

This impact technology has on our lives is like air. It is always around us, it constantly affects us while we're sleeping or awake, it decides how much we pay for certain things, etc.

The best way to prove that indeed technology is consistently affecting our lives would be to take a look at a typical day in the life of Mr. Tom Tech—1987.

Mr. Tech awakes on a typical work day to the sound of his digital alarm clock playing music. About this same time the pinkish sodium vapor street lights outside are automatically turned off by a light sensitive sensor. Mr. Tech pulls himself out of his waterbed where the water temperature has been maintained by the use of a thermostat. Mr. Tech then proceeds to take a shower using a shower head that is a water saver device that also has the ability to make the water spray to be hard or soft and oscillate. After showering Mr. Tech brushes his teeth using a plastic polypropylene toothbrush.

Mr. Tech dresses himself for work selecting clothing that contains rayon, dacron, tricel triacetate and polyester and puts on a digital wrist watch. Before leaving for work Mr. Tech heats a cup of leftover coffee using the microwave oven. He also feeds the family dog a Purina product that contains diacalcium phosphate, pyridoxine hydrochloride, chlorine chloride and other yummy things. Mr. Tech also provides the family dog a bowl of water that has

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Kline, S. (1985). *What is technology?* Paper presented at Stanford University, Stanford, CA.

been chemically treated and deemed appropriate by state officials to be safe for (even) human consumption.

As Mr. Tech leaves the house, he pushes a button that opens the garage door. After entering his car he starts the vehicle that has electronic ignition, on-board computer, fuel injection, and a unitized body that was welded together by robots. As Mr. Tech drives away he closes the garage door using a remote controlled device clipped to the sun visor. The trip to work is partly on interstate highways that were made with concrete and additives that resist cracking and other deterioration. On the trip to work, he encounters traffic lights that are synchronized by reflective and pressure sensitive sensors. Mr. Tech also notices the smooth ride due to his gas-filled shock absorbers.

Arriving at work, Mr. Tech begins his work by taking an elevator to the second floor where his office is located. Once Mr. Tech settles in his rayon, polyester and urethane chair he admires a 24 lb. lake trout on his wall that was stuffed using polystyrene beads finished with urethane varnish. Mr. Tech spends much of his day using the telephone to conduct business. These telephone calls are usually long distance a process which utilizes switching stations, fiber optic cables, and sometimes conference calling capabilities. Mr. Tech also frequently writes letters that he gives to his secretary who produces letter perfect correspondence using a word processing package and a computer. Mr. Tech also uses a computer to perform many duties throughout the day.

During the noon hour, Mr. Tech frequently takes the elevator to the basement level of the building where a cafeteria is located. Once in the cafeteria Mr. Tech selects a candy bar that contains sodium bicarbonate, soya lecithin, etc. as well as a bag of potato chips that contains monosodium glutamate, dextrose, sodium caseinate and finally a can of soda which contains phosphoric acid. Mr. Tech has obviously never heard of a hamburger!

After lunch Mr. Tech returns to his office and continues work until it's time to go home. After the drive home, Mr. Tech enters his house and turns on a light. The light is powered by the nearby electric producing, coal fired power plant.

Mr. Tech passes this plant on his way to work each day and wonders if what comes out of those smoke stacks may contribute to the pollution problem his city is fighting.

Mr. Tech then opens his mail. Like most of us there are more bills than any other kind of mail. Mr. Tech opens his natural gas bill. He notices that the bill was computer generated, complete with an estimated amount of fuel consumption. Finished with the mail, Mr. Tech goes to the house thermostat in an effort to make the house more comfortable. It dawns on Mr. Tech that this simple device which we rely on so much is rather complex, as this electronic device makes decisions and does work for us by turning on and off heating and cooling systems.

After the evening dinner of computerized corn fed beef roast and side dishes, Mr. Tech decides to watch an evening T.V. show. He turns on the T.V. using an infrared remote controller and finds his favorite show on Channel 22 off the G.1 bird. If this is Greek to you that is because Mr. Tech happens to own a T.V. Satellite Receiving System. G.1 is a designation for an orbiting satellite known as Galaxy 1, which carries 24 channels. Channel 22 is referred to as the Discovery Channel and offers many shows of a science and technology related nature.

Turning off the T.V., Mr. Tech retires for the evening in anticipation of another day in the life of Mr. Tech.

If this day in the life of Mr. Tech seems rather normal, that is because it is. What has been described to you is a typical day in the life of this author. What this day in the life of Mr. Tech does, is bring to light the variety of technologies that we come in contact with on a daily basis and probably do not realize. Yet give a moment to hink how your life would be affected if the technologies listed were not available. Not all of these technologies are newly created, i.e., elevator, thermostat, etc., but yet we as humans take these for granted and rely on them to help our lives.

Activities

1. Have students study the newspaper for reports on ways technology helps them and others. Have students also find ways technology is harmful to people. Have students suggest ways that the harmful consequences can be eliminated.

2. Have students play the following games:
- Future—Ed.; Cost $14.99
- Techno—Consequences Pros and Cons; Cost $19.99

Both available from
Transtech Systems
Division of Creative Learning Systems, Inc.
9889 E. Hibert Street
San Diego, CA 92131

3. Have students view appropriate audiovisual materials—see the Appendix.

4. Play the game: "Pass It On": Choose some significant insight, information, concept or example relating to an impact of technology that you feel some individual or group of people should become aware of. Identify the content and the population, then develop the means to teach them. The population may be other students, the general public, parents, teachers, brothers, sisters, etc. The mode may be overheads, tapes, handouts, letters to the editor, speeches, etc., but when turned it should be in completed form, ready to be transmitted.

LEARNING ACTIVITY PACKET **2**

Types of Impacts

Prerequisite LAP(s): 1

LAP Objective
To state that technology impacts our lives in four ways.

LAP Competencies
1. To describe what environmental impact is.
2. To describe what technical impact is.
3. To describe what financial impact is.
4. To describe what social impact is.

Most all technology related literature gives attention to the issue of how technology has impacted our lives. It is, however, not a clear delineation of just how technology impacts occur. Most technology related texts deal with this issue by using the following kinds of titles:

Dorf, R. C. (1974). *Technology and Society*, New York: Boyd and Franser.
- The Control of Technology
- Technology, Social Values and Social Responsibility
- The Social Consequences of Technology
- Technology and Ecology
- Technology, Affluence and Population
- Technology and Social Problems
- Economics and Environmental Control
- Energy Resources, Use and Policy
- Technology and the Future
- Limits to Growth

Pytlik, Lauda, & Johnson, (1978). *Technology, Change and Society*, Worcester, MA: Davis.
- Technology and Human Life
- Technology and Society
- Technology, Health, and Medicine
- Technology, Work and Leisure

DeVore, P. (1980). *Technology An Introduction*, Worcester, MA: Davis.
- Education and Technology
- Human Problems and Political Issues
- Technology in the Service of Humankind

Bame, A. & Cummings, P. (1980). *Exploring Technology*, Worcester, MA: Davis.
- Consequences of Technology

Heiner & Hendrix, *People Create Technology*, Worcester, MA: Davis Publishing.
- Systems Resulting from Technology
- Products and Problems Resulting from Technology
- People's Role in Changing Technology

Badrkhan, Daggett & Williams, (1985). *Technology for Tomorrow*, Cincinnati, OH: South-Western.
- The Effects of Technology
- Technology and Change

McCrory, Todd & Todd, (1985). *Understanding and Using Technology*, Worcester, MA: Davis Publishing.
- Personal Consequences
- Physical Effects
- Emotional Effects

TECHNOLOGY	IMPACT	TYPE OF IMPACT
Robotics	Displaced Workers	Financial/Social
Coal Burning Electric Power Plants	Acid Rain	Environmental
GMC on-board computer	Inservice for Auto Repairman	Technical
GMC on-board computer	Raised the price of a new car $170	Financial

- Social Consequences
- Ecological Consequences

If we were to more closely analyze these topics and "read between the lines," we would find that for the most part, technology impacts our lives in four basic ways. These types of impact are:

- Environmental
- Technical
- Financial
- Social

This figure shows that the technology of robotics has impacted our world by displacing some workers. This in turn means the type of impact is *financial* for those workers that were displaced. It is also a *social* impact as we now take a new perspective on how labor forces are recruited and managed. Note: Let it be clear that robotics has impacted our world in many other ways and that displacing workers is only one example.

A second example would be coal fired-electric power plants that emit nitrogen oxide and sulphur dioxide from their smoke stacks. These chemicals float in the atmosphere to be returned to earth with rain drops and is commonly called acid rain. Acid rain has an *environmental* impact as it causes far reaching problems with vegetation, fisheries and wild life.

The third example is the GMC on-board computer that was introduced in 1981. This meant every service repairman had to have some additional training so that they would know how to work on this new device when it came into their shop. If they did not know how to properly perform maintenance they would lose the job as the customer would take the car to someone that could make the needed repairs. This was a *technical* impact for all auto service technicians.

The last example also uses the GMC on-board computer. Another way this device caused an impact is *financially*. One impact was that it raised the price of an average car $170. Every person who has bought a car with an on-board computer since 1981 has paid that extra amount. Another *financial* impact that has ties to the example was in the cost of retraining all GMC service personnel. It is safe to assume that cost also got passed along to the customer.

Let us conclude this LAP by again making the point that we are impacted in four basic ways and that we need to recognize these impacts so that we can deal with them appropriately. There is also a need to analyze all future developments with respect to how we might be affected should this development become reality.

Activities

1. Have the students collect a variety of newspaper and magazine articles dealing with the issue of impacts.

2. Have the class view appropriate audio visual materials.

3. Give a report to the class on a population that would live completely in space. Include all aspects of life from food, to homes, transportation, power, jobs, etc.

4. Have students perform the following task and hold class discussion after.

[*Quoted from Technology: An Introduction, by Paul DeVore, reprinted with permission of Davis Publishing.*]

Technology—An Introduction

The innovations and inventions listed can assist in developing insight into the relationships between new technical means and technical and social change. This can be done by selecting several innovations and/or inventions of interest. Using a scale of 0 to 10 (0 = no impact; 10 maximum), estimate the magnitude of the technical (T) and social (S) impact. After estimates are made, conduct a case study of each invention or innovation selected. Compare actual magnitudes of impact with estimated magnitude.

INNOVATION OR INVENTION	MAGNITUDE OF IMPACT	
	Technical	*Social*
1. Automatic transmission	____	____
2. Heatproof, high-strength plastics	____	____
3. Bakelite	____	____
4. Precision casting, forging and moulding	____	____
5. Ballpoint pen	____	____
6. Catalystic cracking of petroleum	____	____
7. Powder metallrgy	____	____
8. Synthetic fabrics	____	____
9. Digital computer	____	____
10. Continuous casting of steel	____	____
11. Tufting	____	____
12. Transistor	____	____
13. Numerical control	____	____
14. Television	____	____
15. Fission power	____	____
16. Hydromagnetic power	____	____
17. Fuel cells	____	____
18. Cellophane	____	____
19. Continuous hot strip rolling	____	____
20. Lifelong education	____	____
21. Tungsten carbide	____	____
22. Zip fasteners	____	____
23. Radial tires	____	____
24. Integrated circuits	____	____
25. Wash-wear treatments for cotton fabric	____	____
26. Sanforizing	____	____
27. Texturized synthetic yarns	____	____
28. Nonwoven fabrics	____	____
29. Velcro	____	____
30. Electrical discharge machining	____	____
31. Electrochemical machining	____	____
32. Chemical milling	____	____
33. Explosive forming	____	____
34. Stretch forming	____	____
35. High strength concrete	____	____
36. Prestressed concrete	____	____
37. Plywood	____	____
38. Particle board	____	____
39. Tower crane	____	____
40. Prefabricated building units	____	____
41. Collision avoidance systems	____	____
42. Transponders	____	____

INNOVATION OR INVENTION	MAGNITUDE OF IMPACT	
	Technical	*Social*
43. Coal gasification	____	____
44. Light emitting diodes	____	____
45. Magnetohydrodynamics	____	____
46. Linear induction motors	____	____
47. Fuel injection	____	____
48. Electronic ignition	____	____
49. Opaque-2	____	____
50. Supercritical wing	____	____
51. Vinyl chloride	____	____
52. Compound vortex controlled combustion	____	____
53. Video tape cassettes	____	____
54. Separate condenser for steam engine	____	____
55. Sewing machine	____	____
56. Linotype	____	____
57. Motion pictures	____	____
58. Color television	____	____
59. Airplane	____	____
60. Tricycle landing gear	____	____
61. Inertial guidance	____	____
62. Helicopter	____	____
63. Polaroid camera	____	____
64. Lear jet	____	____
65. Body transplants	____	____
66. Immunization	____	____
67. Silicones	____	____
68. Stainless steel	____	____
69. Streptomycin	____	____
70. Artificial hearts	____	____
71. Heart pacers	____	____
72. Chromosome tests of fetus	____	____
73. Surface effect vehicles	____	____
74. Sulzer loom	____	____
75. Chlordane	____	____
76. Cloning	____	____
77. Molecular enginering of genes	____	____
78. Fertilization *in vitro*	____	____
79. Aldrin	____	____
80. Float glass	____	____
81. Synthetic detergents	____	____
82. Ekistics	____	____
83. Wankel engine	____	____
84. Phototypesetting	____	____
85. Moulton bicycle	____	____
86. Basic oxygen process for steel making	____	____

INNOVATION OR INVENTION	MAGNITUDE OF IMPACT	
	Technical	*Social*
87. Xerography	____	____
88. Tetraethyl lead	____	____
89. Titanium	____	____
90. Diesel engine	____	____
91. Management information systems	____	____
92. Color photography	____	____
93. Long playing record	____	____
94. Magnetic tape recording	____	____
95. Optical readers	____	____
96. Industrial robots	____	____
97. Methyl metacrylate polymers	____	____
98. Neoprene	____	____
99. Nylon	____	____
100. Video tape cassette	____	____
101. Penicillin	____	____
102. Polyethylene	____	____
103. Power steering	____	____
104. Holography	____	____
105. Stereoscopic cinema	____	____
106. Radio	____	____
107. Radar	____	____
108. Liquid fueled rockets	____	____
109. Safety razor	____	____
110. Hybrid corn	____	____
111. Artificial foods	____	____
112. Desalination of sea water	____	____
113. Self-winding wrist watch	____	____
115. X-ray	____	____
116. Automatic pilot	____	____
117. Eight track tape	____	____
118. Laser	____	____
119. Cryogenics	____	____
120. Calder Hill atomic power plant	____	____
121. DNA module	____	____
122. Steam turbine	____	____
123. Sleeping car	____	____
124. Railway air brakes	____	____
125. Automobile	____	____
126. Synthetic ammonia	____	____
127. Micrometer	____	____
128. Manganese steel	____	____
129. Aluminum reduction	____	____
130. Thermite welding	____	____
131. Incandescent lamp	____	____
132. Electric transformer	____	____
133. Neon light	____	____
134. Hydraulic cement	____	____
135. Portland cement	____	____
136. Cylinder lock	____	____
137. Barometer	____	____
138. Hygrometer	____	____
139. Thermoelectric power	____	____
140. Thermionic power	____	____
141. Cotton picker	____	____
142. Hovercraft	____	____

INNOVATION OR INVENTION	MAGNITUDE OF IMPACT	
	Technical	*Social*
143. Hydrofoil	____	____
144. Container ships	____	____
145. Crease-resisting fabrics	____	____
146. VTOL (Vertical Take-off and Landing)	____	____
147. STOL (Short Take-off and Landing)	____	____
148. Cyclotron	____	____
149. DDT	____	____
150. Supersonic airplane	____	____
151. Diesel-electric railway traction	____	____
152. Fluorescent lighting	____	____
153. Telephone	____	____
154. Telegraph	____	____
155. Cable television	____	____
156. Picturephone	____	____
157. Gyrocompass	____	____
158. Facsimile transmitters	____	____
159. Analog computer	____	____
160. Typewriter	____	____
161. Hardening of liquid fats	____	____
162. Insulin	____	____
163. Turbine Engine	____	____
164. Reciprocating four-stroke cycle	____	____
165. Internal combustion engine	____	____
166. Power loom	____	____
167. Reaper	____	____
168. Steel plow	____	____
169. Condensed milk	____	____
170. Refrigeration	____	____
171. Daguerreotype photography	____	____
172. Microphone	____	____
173. Flexible roll film	____	____
174. Halftone engraving	____	____
175. Superherterodyne radio circuit	____	____
176. Frequency modulation	____	____
177. Electric motor	____	____
178. Electric generator	____	____
179. Pneumatic rubber tire	____	____

LEARNING ACTIVITY PACKET **3**

Environmental Impacts

LAP Prerequisites: 1, 2

LAP Objectives
To state how and who various technologies may impact our society environmentally.

LAP Competencies
1. To list several examples of environmental impacts.

Environmentalists and ecologists are beginning to make us aware of what humans for centuries have been doing to our natural resources. They observe that for generations people have been using raw materials, processing them and pouring pollutants in the rivers, oceans, air and soil. They point out that nature holds a delicate balance. Humans, they charge, are destroying plants, animals and even the air we breathe. Because it takes such a long time for ecological consequences to be discovered, it is difficult to know today how serious the situation will be in the future.

Some scientists point out that humans have always had an effect upon the environment. At the end of the last Ice Age, about 10,000 years ago, herds of wild horses on the North American continent disappeared. This happened in spite of an abundance of grass for food. The best guess is that the horses were slaughtered for food faster than they could reproduce. Finally, there were none left. (Todd, McCrory & Todd, 1985, p. 350). More than nine thousand years later, Spaniards brought horses from Europe. The breeds of horses we now have in the United States are not native to North America, but are descendants of those in the Eastern Hemisphere.

Investigations by archeologists indicate that wherever humans have migrated, the balance of nature has been changed. About 12,000 years ago, humans moved across a land bridge that used to connect what is now Russia and Alaska. This seems to be the most plausible explanation why Alaskan Eskimos have physical and cultural characteristics akin to Oriental people. Prior to that time, the musk ox lived on the north and south sides of glacial ice covering most of Canada. Soon after these Stone Age humans migrated into North America, the musk ox began to disappear. Because the northern side of the glacier was inaccessible to these early people, the animal survived and prospered there for centuries. (Todd, McCrory, & Todd, 1985, p. 350).

Some of the consequences of technology on plants and animals are easily observed. There are also important effects that we cannot see. Consider the following chain of relationships.

[*Quoted from Understanding and Using Technology, with the permission of Davis Publishing.*]

The earth is surrounded by a relatively thin layer of gases. This layer of air, the biosphere, sustains all living things. The air we breathe consists mainly of three important gases: oxygen (21%), nitrogen (78%) and carbon dioxide (less than 1%).

Bacteria and algae in the soil take nitrogen from the air and convert it to ammonia. Ammonia is poisonous to humans. Fortunately, other microorganisms convert the ammonia into nitrates. Nitrates are needed by green plants to produce proteins and oxygen. Animals in turn eat the proteins and breathe the oxygen. When animals and plants die, their protein is converted back to ammonia and the cycle continues. Life abounds! If ever there are not enough green plants left, humans will be in trouble.

Surely we recognize the importance of nature's life cycle in the biosphere. Or do we? For many years, vast amounts of a chemical called 2,4D ("Agent Orange") have been used in highly developed countries to kill weeds. During the Vietnam War, 2,4D was sprayed from planes to wipe out entire forests. Few questions were raised until years later, after the damage was done. Not only were green plants destroyed, but 2,4D turns out to be extremely dangerous for humans as well.

Ecological consequences change the balance between the living and the non-living things in the biosphere. Recently, scientists and concerned citizens have begun to investigate the possible consequence of many events such as:

- Excess burning of fossil fuels.
- Dumping of waste materials and garbage into rivers, lakes and soil.
- Nuclear testing and its resulting atomic fallout.
- Use of pesticides and weed killers.
- Oil leaks from ship wrecks or offshore drilling.
- Storage of nuclear waste.

There are difficulties in determining the possible consequences of technology. One difficulty is that the effects may become apparent only after a harmful chain of events has been started. Once that sequence has begun, it may take a long time for it to be stopped, if it can be stopped at all.

For example, we are presently producing, using and discarding massive amounts of plastics each year. We do not know yet if those plastics will decompose and become harmless compounds. The decomposition of plastics is unique. There are some indications that plastics break down into new and dangerous compounds. Compounds never before found in nature are now emerging. We simply do not know what effects these may have. We will have to live with the consequences, whatever they are, for it is too late to stop the process.

Nuclear testing is another example of an activity which has long-term consequences. A large number of nuclear devices were exploded both underground and in the atmosphere between 1948 and 1964. Halfway through that period, some scientists indicated that we need not worry about the level of radioactivity in the atmosphere. By 1964, scientists found that radioactivity was poisoning our atmosphere, our soil, our food and even the milk we drink. They realized that we had reached a crisis. They stopped the cause of the crisis, nuclear testing. That could not stop the chain of events, however. For some years to come, we may be affected by the consequences. Two radioactive isotopes (strontium 90 and cesium 137) accumulate in our foods and in our bodies. Radioactivity can be harmful.

We are still waiting to see the effects of radioactive nuclear wastes. We already know that the materials in which nuclear wastes are now stored wear out and leak in less than a half a century. Nuclear wastes remain radioactive and potentially harmful for several centuries, however.

From Understanding and Using Technology, pp. 349-354, used with permission of Davis Publishing.

Activities

1. Have students collect a variety of newspaper magazine articles dealing with environmental impact issues.

2. View material on air pollution, water treatment, noise, toxic substances, solid waste, land erosion, etc.

3. Have classroom debates on various environmental issues. Example: Should we continue to use plastics in the volume we have become accustomed to, when we do not yet know how well plastic will decompose?

4. Have students play the game, "Energy and the Environment—Pros and Cons."
Available from
Transtech Systems
Division of Creative Learning Systems, Inc.
9889 E. Hibert Street
San Diego, CA 92131
Cost—$19.99

5. Have students interview city officials, engineers, and politicians on a particular environmental issue.

6. Have students discuss what waste products are produced by their school. How does the school dispose of these wastes? (Note to teacher: Students should learn that most decisions involve compromise and trade offs; this could be a good place for students to learn this.)

LEARNING ACTIVITY PACKET **4**

Technical Impacts

LAP Prerequisites: 1, 2, 3

LAP Objectives
To understand how and why various technologies may impact our society in a technical manner.

LAP Competencies
1. To list several examples of technical impacts.

[*Quoted from Understanding and Using Technology, reprinted with the permission of Davis Publishing.*]

Tools continue to help us do our work more easily. We have become dependent upon them for even the simplest of tasks. Have you ever tried to open a can of soup without a can opener? If you have a home garden, you have probably used one of the first tools developed by humans—the hoe. Imagine how difficult it would be to do all the weeding by hand.

In almost every job we do, we reach for a tool to help us. Tools extend our use of physical strength. They eliminate some of the hard work experienced by our ancestors. Much of our heavy lifting and hauling is now done by machine. One of the consequences of our easier life today is that our bodies can get "soft."

In technologically-developed countries, physical fitness has become a significant problem. Students are bused to school, then required to participate in physical fitness classes. Adults drive home from work, then go jogging for exercise. Our great-grandparents would have thought that was strange behavior. By making work easier for us, tools can also leave us weaker.

Technology affects our physical health through foods we eat. New varieties of wheat and rice have been developed. Farm machinery and techniques have been improved. More and more grain can be grown now to provide food for a growing population. Giant farms, thousands of acres in size, now almost effortlessly produce what people use to struggle to grow on small farms and gardens. Huge tractors and other expensive pieces of equipment are needed to take care of the harvest. To compensate for the cost of machinery, plant disease and insects must be controlled by chemical sprays. Some of these pesticides remain in the food produced from the crops. Some of these pesticides have long-term effects on us.

In a wild environment, nutrients cycle from the soil into plants and animals and then decay back into the soil. But nutrients taken from the soil by our food plants are not returned to the soil in our present food cycle. Current methods and demands on the food supply deplete our soil. To grow enough food from the available farm land, chemical fertilizers are used and often overused. These are costly and depend on a large energy supply. The foods are altered, too. Vitamins are added to flour to replace those lost in processing, for example.

Without these chemicals, our present system of food production could not exist. The system

is one of the most efficient in the world. But what are the consequences of modern food technology? We depend on a large energy supply to keep our soil replenished. Vitamins added to bread may add years to your life. Other chemicals added to keep the bread soft may be harmful to your body. Many fruits and vegetables are picked before they ripen. They are stored in coolers for shipment during the "off season." This method provides you with apples during the winter, but they are not as nutritious or tasty as those that have ripened on the plant. We have a lot of food, but are only now learning some of the consequences of our methods.

From Understanding and Using Technology, pp. 339-341, used with permission of Davis Publishing.

Activities

1. Have students gather a variety of newspaper and magazine articles that deal with technologies that have an impact technically. Discuss what technical impact there was and may be in the future.

2. View appropriate audiovisual material with your class.

3. Discuss with your students what existing jobs today might not be available in the future as a result of new technologies. Will other jobs be created as a result of this action? If so, what kind of training will these new workers need?

LEARNING ACTIVITY PACKET **5**

Financial Impacts

LAP Prerequisites: 1, 2, 3, & 4

LAP Objectives
To list how various technologies may impact our society financially.

LAP Competencies
1. To list several examples of financial impacts.

Due to man's efforts to make life more comfortable, along with the desire to make our nation more production efficient, numerous technologies have been developed. Virtually none of these technologies has escaped the pattern of causing humans to pay a higher price for this new technology. We ask the question "Why?" Why do we as consumers pay more for these new technologies?

[*Quoted from Understanding and Using Technology, reprinted with the permission of Davis Publishing.*]

For example, rather than have one person make a complete refrigerator, each worker produces a small part. The parts then are put together on an assembly line. Each worker does a specific task.

This practice is called division of labor. It can be quite boring to do the same job over and over again. Bored people do not work very well and problems can develop. Sometimes, on assembly lines, workers purposely attach a part incorrectly or leave it out altogether. Why do you think that might happen?

In earlier times, each worker built a complete product from start to finish. Often the worker knew the customer personally. A barrel-maker (cooper), for example, shaved the wood staves, hammered out the hoops, then carefully fitted them together to form a finished product. Each barrel was a piece of craftsmanship, and there was satisfaction for the worker. But it was a slow process.

As the demand for barrels increased, production had to be increased. At first, some coopers specialized in stave-forming. Others made only the hoops. Still others did the assembly. Eventually, as many as six different workers were involved in the making of a single barrel. None of them ever met the people who bought the products. As labor became more specialized, production of barrels increased. But, pride and satisfaction of the workers usually decreased. Quality also declined. Some industries have recognized this consequence of technology, and have tried new methods of production. The problem, called worker alienation, still persists in many industries.

If indeed industries are going to hire more workers to do what only a few did before, in the interest of efficiency, it only stands to reason that more people means: more payroll, more sick leave, more hospitalization insurance, etc. Thus, these additional costs get passed on to the consumer.

From Understanding and Using Technology, pp. 341-344, used with permission of Davis Publishing.

Some futurists predict that prices will drop as we have seen in the past. Examples: The first digital watch sold for approximately $300. Now one can buy a digital for $4.95. This can be seen time and time again in various products; T.V.s, stereo's, VCR machines, computers, etc.

The reason for these lower prices is due once again to efficiency. We now have even more efficient ways to produce products using robots and other automated machinery. This type of labor does not take time off, does not become ill (like humans), does not strike, does not need insurance, heat or lights to operate. Because of the 24 hour/day production more volume of products can be turned out. Still, however, this automated equipment costs the industry much investment which in turn gets passed on to the consumer.

It seems as though our nation's desire to make life more comfortable is directly proportional to the amount we as a society are willing to tolerate.

Activities

1. Have students look around your classroom and list the items that have had a cost reduction or increase brought on by the advent of a technology.

2. View appropriate audiovisual material.

3. Ask students to collect newspaper and magazine articles that deal with financial impacts. Discuss whether this impact is good or bad for yourself, your family, your school, your community, and what could be done to change it.

4. The telephone, boat, car, camera, etc. have all impacted our society economically. Discuss the cost of these items, or cost of related items to make these items, or as a result of these items the cost of other items with your students.

LEARNING ACTIVITY PACKET **6**

Social Impacts

LAP Prerequisites: 1, 2, 3, 4, & 5

LAP Objectives:
To state how various technologies affect our society in a social manner.

LAP Competencies
1. To list several examples of social impact.

[*Quoted from Understanding and Using Technology, reprinted with the permission of Davis Publishing.*]

Beginning with the very first invention, technology has caused social changes. The technology of farming provided a more reliable food supply than did hunting or foraging. Consequently, people began to form small villages instead of living as nomads. Animals were domesticated for food and to do work. For thousands of years the social structures of tribes and villages changed very little.

When the wheeled plow was invented in Europe during the sixth century A.D., things began to change. Before the wheeled plow, each family farmed its own small plot of land. The wheeled plow required large oxen for power. Families began to join with others to buy teams of oxen. They also combined their small plots into larger farms.

Especially in Europe, this practice led to the development of a communal life style. People in the village began to specialize. Some farmed, others produced clothing, while still others made and repaired tools. All these social changes were related to technological advances and was the beginning to the division of labor concept.

A similar pattern of change has occurred more recently on the plains of the United States. Owners of farms formed "co-ops" — cooperatives. This helps them purchase the large machinery and storage bins required for agribusiness. Together they can store grain and sell it whenever the price is high.

In both examples, a new set of social relationships was formed. People were required to give up some of their individual freedom to benefit from group cooperation. A measure of independence was lost as people became more dependent upon others. Technology, you see, can have both positive and negative consequences.

Inventions do not have to be big to be important. Some small devices can have powerful consequences. The stirrup is an example. Invented more than a thousand years ago, the stirrup changed the course of history. Before the stirrup, people rode bareback or with light saddles. When stirrups were attached to the saddle, the rider could more easily stay on the horse. The horse and rider could work together, thus using more of the horse's strength.

During the eighth century A.D. in Europe, kingdoms were warring among themselves for control of land and riches. A leader of the French, Charles Martel, observed that stirrups enabled his mounted troops to use long steel

lances as battering rams. The stirrups gave them the power to overwhelm the soldiers on foot or the mounted warriers without stirrups.

To increase the number of mounted troops, Martel promised plots of land to those who would join his army. He soon had a vast force of mounted warriors. Martel and his son, Charlemagne (also called Charles the Great), built an empire that lasted for a century. When the troops disbanded, descendants of the original mounted troops claimed the land they had been promised. Each landowner ruled a mini-kingdom, complete with knights, serfs and all the trappings of Camelot. And it all began with the stirrup.

Each of these examples—plow and stirrup—has influenced the development of humans and their social structures. The development of humans and technology is closely connected. Consider two ideas that are very important:

1. Technology is a product of humans.
2. Humans are influenced by technology. In a sense, we are "products" of technology.

It may be easy to accept the first notion, but what about the second one? It means that the shape of our hands, the volume of our brains, our social patterns and even the way we think are consequences of technology. Furthermore, technology will probably continue to change us in the future. We may not like some of the changes, but yet we can change the outcomes if we feel strongly enough to do so.

From Understanding and Using Technology, pp. 346-348, used with permission of Davis Publishing.

Activities

1. View appropriate audiovisual materials.

2. Have your class collect a variety of newspaper and magazine articles that deal with social impacts. Have class discussion on the impact and what could be done to alter the impact.

3. Have students play the game: "Genetics Pros and Cons," *Available from*
Transtech Systems
Division of Creative Learning Systems, Inc.
9889 E. Hibert Street
San Diego, CA 92131
Cost—$19.99.

4. Have class members imagine what your life would be like without technology. Discuss what life may be like. Food, jobs, transportation, energy, etc.

5. Have students write a personal scenario of a part of their life impacted by technology in the Year 2000.

LEARNING ACTIVITY PACKET **7**

Technology Assessment

LAP Prerequisites: 1, 2, 3, 4, 5, & 6

LAP Objectives
To state what technology assessment is and become familiar with the Office of Technology Assessment.

LAP Competencies
1. To define technology assessment.
2. To become familiar with the Office for Technology Assessment.

[*Quoted from Understanding and Using Technology, reprinted with the permission of Davis Publishing.*]

New technologies are being developed each day. In some cases, new products and processes are being discovered faster than we can learn how to deal with them. Nuclear energy sources, for example, are being developed even though we are not yet sure of their long-range effects on human health. Because of this, it is becoming more important that the possible effects of new technologies be evaluated before they are put to use. The process of systematically evaluating new technologies is called technology assessment. This is a study of the immediate and the delayed effects which result when an aspect of technology is introduced or changed. It is a study of technology's planned and unplanned effects on individuals, society and our ecosphere.

The need for technology assessment is not new. The Roman aqueducts, built nearly two thousand years ago, were constructed almost entirely by muscle power. Hoists, winches and a variety of other mechanical devices were available but were seldom used. Apparently the Romans believed it was more important at the time to get the job done than to develop new machines. This kept large numbers of workers and slaves busy but did little to advance the level of technology. Water delivered to the city of Rome by the aqueduct system was distributed to most people through public fountains. The nobles had their water piped into their homes. The pipes were made of lead which is poisonous. The water system slowly killed the leaders of Rome through lead poisoning. Some historians believe this was one important reason leading to the fall of the Roman Empire. If the Romans had the proper knowledge/tools and deployed technology assessment, they might have avoided this.

There was a time when all new technologies were widely accepted without question. Today people are beginning to be more cautious. The Congress of the United States now uses an Office of Technology Assessment. [Congress of the United States, Office of Technology Assessment, Washington, DC 20510; (202/224-8996).] The people in the office investigate the possible effects of new technological developments. The effects on people and the environment are carefully examined. Detailed reports are made to Congress. These help our legislators make decisions related to the new developments.

Special interest groups and consumer unions also help watch over new technologies that

might be dangerous. Sometimes technology assessment slows down the process of implementing new technologies. For example, when a new fuel processing plant is proposed, it may require years of public study before construction can begin. During this time, numerous citizen groups and government agencies study and debate the good and the bad aspects of the plant.

New technologies can be evaluated for their potential effects and consequences. This evaluation, called technology assessment, helps us reduce future dangers to humankind.

As the pace of change quickens, it becomes more important than ever to forecast and plan for the future. A new field called future studies has evolved. People who specialize in this field (futurists) have developed several methods of forecasting, including:

- Trend projection
- Analogies
- Surveys
- Networking
- Future histories
- Scenarios
- Modeling

Each of the methods can be useful to look into the future. If possible futures are identified, then people can make better choices in the present.

A favorite quote seems appropriate to sum up this unit: "For every technology that is developed, certain consequences must be accepted."

These consequences may sometimes be positive or negative, but they become ours to deal with.

How Assessment Works

[Quoted from Technology and Society, reprinted with permission of Boyd & Frazer Publishing Company.]

The methodology of technology assessment currently contains seven steps. The first step is to define the assessment task, establish the scope of the assessment and discuss the relevant issues. Then the major technology and other supporting technologies are described. The third step is to identify and describe major technological factors influencing the application of the relevant technologies. Then the areas of impact are identified. For example, major areas of impact might be the environment, demography or social values. The fifth step is to make a preliminary impact analysis. Next, the possible action alternatives are identified. This step calls for the development and analysis of various programs for obtaining maximum public advantage from the assessed technologies. The final step is to complete the impact analysis by analyzing the degree to which each action alternative would change the specific societal impacts of the technology being studied.

Of course each step in making a technology assessment is closely linked to every other step. Also, an iterative procedure may be the most complete. The multidisciplinary systems approach is well-suited to preparing technology assessments. In order to be accepted by the public, technology assessment must be reliable and credible. This requires systematic methods for developing assessments—methods which can be repeated.

In preparing assessments, questions of value arise. It becomes difficult to quantify or to pose objective questions to all the issues in an assessment. If this is true, then it may be equally difficult to prepare credible assessments which can be repeated. (There is some fear that anyone advocating a particular project can justify it through a technology assessment.)

Because technology assessment, in its broadest definition, is the anticipation and evaluation of the impacts of a technological development on all sectors of society, including the economic, environmental, social, political, legal and institutional components, it will be difficult to satisfy this definition in an objective or bias-free manner.

Also, technology assessment is limited in its scientific basis. In extrapolating from the past to the future, there is no firm basis to assure us that the future will resemble the present or the past. The political, social and institutional changes in our society as a result of technological changes are only partially understood. We did not foresee the effect of the automobile on our social institutions or the long-term effects of pesticides, let alone the effects of electronic surveillance devices on our politics, ethics and morality.

From Understanding and Using Technology, pp. 332-334, used with permission of Davis Publishing.

From Technology and Society, pp. 294-295, used with permission of Boyd and Fraser.

Technology and Values

[Quoted from Technology and Society, reprinted with permission of Boyd & Fraser Publishing Company.]

New technology also means a high probability of change in individual and social values, because it alters the conditions of choice. It is often customary to distinguish rather sharply between individual and social values and, in another dimension, between tastes or preferences, which are usually taken to be relatively short-term, trivial, and localized, and values, which are seen as higher-level, relatively long-term, and extensive in scope. However, useful for some purposes, these distinctions have no standing in logic, as Kenneth Arrow points out:

One might want to reserve the term "values" for a specially elevated or noble set of choices. Perhaps choices in general might be referred to as "tastes." We do not ordinarily think of the preference for additional bread over additional beer as being a value worthy of philosophic inquiry. I believe, though, that the distinction cannot be made logically. . . ."

The logical equivalence of preferences and values, whether individual or social, derives from the fact that all of them are rooted in choice behavior. If values be taken in the contemporary American sociologist's sense of broad dominant commitments that account for the cohesion of a society and the maintenance of its identity through time, their relation to choice can be seen both in their genesis (historically in the society, not psychologically in the individual) and in their exemplification (where they function as criteria for choice).

Since values in this sense are rather high-level abstractions, it is unlikely that technological change can be seen to influence them directly. We need, rather, to explore what difference technology makes for the choice behaviors that the values are abstractions from.

From Technology and Society, pp. 304-305, reprinted with permission of Boyd and Fraser.

Activities

1. Have the class or individual students write or call to the Office of Technology Assessment and request the pamphlet: What "OTA Is," "What OTA Does," "How OTA Works." After receiving this free pamphlet, have students give reports on the activities of OTA.

2. Have students write or call The Office of Technology Assessment and request the pamphlet: OTA—List of Publications. After securing the pamphlet have the class list those publications that have social, technical, environmental or financial impacts. Have students order a summary article from one or more areas of impact. Example: "Acid Rain and Transported Air Pollutants: Technology and Public Policy—Summary" is available free of charge.

3. Have students report on how the OTA develops a summary report secured in Activity #2.

4. Have students write to other protection agencies such as EPA.

5. Briefly trace the history of an emerging technology. Describe the present condition and explore the impacts if it continues to grow and develop. Example: gene splicing.

6. Have students play. Technology: Good or Bad?

Technology: Good or Bad?

Directions:

A. Identify an invention that has made your life better.

B. List several negative and positive impacts this invention has made.

C. How could you counter one of the negative impacts?

D. How could you take advantage of one of the positive impacts?

Invention _____

Negative Impacts _____

List | **Ways to counter**

Positive Impacts _____

List | **Ways to take advantage**

LEARNING ACTIVITY PACKET **8**

Terminology

LAP Prerequisites: 1, 2, 3, 4, 5, 6, & 7

LAP Objectives
Students should be able to define the terms contained in this Learning Activity Packet.

LAP Competencies
1. Define the terms of LAP #8.

Terms

Technological Impacts—A consequence or result of some preceding action(s). Impacts may be desired or undesired, expected or unexpected.[1]

Environmental Impacts—The effects upon the land, water and air created by a technology.[1]

Technical Impacts—The effects upon tools and procedures at work created by a technology.[4]

Financial Impacts—The effects upon money, goods and services created by a technology.[4]

Social Impacts—The impacts, both positive and negative, of a technology upon a society.[1]

Technology Assessment—Evaluation of technologies for their effects and consequences.[4]

Environmentalists—Those who are concerned about the safeguard of the natural environment against pollution.[4]

Ecologists—Those who are concerned about the relationship of organisms and their environment.[1]

Biosphere—The layer of air around the earth that sustains life.[2]

Futurists—People who forecast and plan for the future.[2]

Values—Things, beliefs, actions, attitudes and institutions that are deemed to be worthwhile.[1]

Change—The art of adapting to conditions around us.[3]

Activities

1. Have students identify definitions to terms on a matching test.

2. Secure study cards of scientific and technical terms from:

Visual Education Association
581 West Leffel Lane
P.O. Box 1666
Springfield, OH 45501
800/543-5847
Cost: $6.95

[1] *Introduction to technology—grade 7, draft syllabus.* (1985). Albany: New York State Education Department.

[2] Todd, R. McCrory, D. & Todd, N. (1985). Understanding and using *technology*. Worcester, MA: Davis.

[3] Williams, Badrkham, & Dagget. (1985). *Technology for tomorrow.* Cincinnati, OH: South-Western Publishing.

APPENDIX A

Suggested Texts

Appropriate Visions: Technology, the Environment and the Individual by Richard Dorf and Yvonne Hunter, San Francisco, CA.

The Closing Circle: Nature, Man and Technology by Barry Commoner (1972); from Alfred Knopf Publishing, New York, NY.

The Existential Pleasures of Engineering by Samuel Florman (1976) from St. Martin's Press, New York, NY.

Exploring Technology by Allen Bame and Paul C. Cummings (1980), from Davis Publishing, Worcester, MA.

Growth and Its Implications for the Future by Elizabeth Gray, David Gray and William Martin (1975); from Dinosaur Press, Brandford, CT.

The Myth of the Machine, Technics and Human Development by Lewis Mumford (1966), from Harcourt Brace, New York, NY.

People Create Technology by Heiner and Hendrix (1980), from Davis Publishing Worcester, MA.

Small is Beautiful: Economics as if People Mattered by E. F. Schumacher (1973), from Harper and Row, New York, NY.

Technology, An Introduction by Paul W. DeVore (1980), from Davis Publishing, Worcester, MA

Technology and American Economic Growth by Nathan Rosenberg (1972), from Harper and Row, New York, NY.

Technology and Social Shock by Edward Lawless (1977), from Rutgers University, New Brunswick, NJ. This book is full of case studies and makes interesting reading, plus it is an excellent reference for a case study format.

Technology and Society by R. C. Dorf (1974) from Boyd and Franser Publishing, New York, NY.

Technology Change and Society, Pytlik, Donald Lauda and Johnson, (1978), from Davis Publishing, Worcester, MA.

Technology for Tomorrow by Badrkhan, Daggett and Williams (198..), from South-Western Publishing, Cincinnati, OH.

Technology, Society and Man by Richard Dorf (1974), from Boyd and Fraser Publishing is available at the University of Wisconsin—Stout Bookstore: Price: $8.30.

Utopia or Oblivion: The Prospects for Humanity by R. Buckminster Fuller (1969), from Bantam Books, New York, NY.

The following materials are all available from IPC Science and Technology Press, PO Box 63, Westbury House, Bury Street, Guildford, Surrey, England GU2 5BH.

1. Oil and Gas Resources
2. The Future Directory by John McHale and Magda Cordell McHale
3. Applied Ergonomics Handbook
4. Renewable Energy Resources by P. L. Auer
5. Commission to the World Energy Conference.
6. Energy Analysis by John A. G. Thomas
7. Energy in the Balance
8. Energy Resources: Availability and Ra-

tional Use; Digest of the Tenth World Energy Conference
9. Nuclear Resources by J. S. Foster, et. al.
10. Technology Assessment and the Oceans by Philip D. Wilmot and Art Slingerland
11. World Energy Demand by I. J. Bloodworth, et. al.
12. World Energy: Looking Ahead to 2020, Report of the Convention World Energy Resources 1985–2020

APPENDIX B

Suggested Filmstrips

Available from
Knowledge Unlimited
Box 52
Madison, WI 53701 ■ 800/356-2303

1. Air Pollution
2. Artificial Intelligence
3. Colonies of Space: The Frontiers Beyond Earth
4. Digital Sound: The New Communications Revolution
5. Energy: Conserving a Vital Resource
6. Energy For The Future
7. FUSION: The Ultimate Energy Answer?
8. Inflation — Parts 1 and 2
9. The City And Its Problems
10. The Nuclear Power Debate
11. Toxic Wastes: The Fouling of America
12. Water: A Vital Natural Resource In Trouble

Available from
Bergwall Productions, Inc.
PO Box 238
Garden City, NY 11530 ■ 800/645-3565

1. Energy Alternatives
2. Energy Alternatives II
3. Fusion Energy: Hope for the Future
4. Passive Solar House Design

Available from
The Center for Humanities
Communications Park
Box 1000
Mount Kisco, NY 10549 ■ 800/431-1242

1. Air Pollution: Causes, Effects . . . and Remedies
2. Biological Catastrophes: When Nature Becomes Unbalanced
3. Cities in Space: Fantasy or Future Fact?
4. Critical Issues In Science and Society: A World to Feed
5. Critical Issues In Science and Society: The Great Energy Debate
6. Energy: Understanding and Managing a Critical Resource
7. Living With a Limit: Practical Ideas for Energy Conservation
8. Nuclear Energy: Peril or Promise?
9. Nuclear Energy: The Scientific Facts
10. The Science and Ethics of Population Control: An Over-Burdened Earth?
11. Water Pollution: Causes, Effects . . . and Remedies

APPENDIX C

Suggested Videos

Available from
Agency for Instructional Technology
Box A
Bloomington, IN 47402 ■ 800/457-4509

1. You, Me and Technology Series
- Americans and Wheels—personal freedom versus environmental costs
- China, Japan, and the West—transfer of technologies
- Communication—the expanding world
- Decisions, Decisions, Decisions—information processing
- Energy and Societies—alternative energy sources
- Feeding the World—agricultural technology
- Living with Technology consumerism
- Risk and Safety with Technology—a risk-free society is not possible
- Social Effects of Health Technology—costs and benefits
- Technological Change and Population Growth—energy and materials management
- Technology Spiral—four technology revolutions
- Transportation—evolution of the urban areas

Available from
The Center for Humanities
Communications Park
Box 1000
Mount Kisco, NY 10549 ■ 800/431-1242

1. Acid Rain: The Choice Is Ours
2. Energy and Nuclear Power
3. Power Without End

APPENDIX D

Suggested Films

Available from
Modern Talking Picture
500 Park Street, North
St. Petersburg, FL ■ 813/541-5763

1. A Play Half Written—The Energy Adventure
2. A Portrait of Power
3. Clean Water: What's In It For You
4. Energy for the 80's
5. Energy for the North Sea Challenge
6. Energy from the Day Star
7. Energy: The Nuclear Alternative
8. Energy: A Quest for Energy
9. Information—Handle with Care
10. Mining and the Environment
11. Nuclear Energy: A Perspective
12. Radiation . . . Naturally
13. Recycling: A Way of Life
14. The Energy Experience
15. We're On Our Way
16. Westward Coal
17. Windows in Time: Research Today for Energy Tomorrow

Available from
U.S. Environmental Protection Agency
230 S. Dearborn Street
Chicago, IL 60609

1. Air Pollution and Plant Life
2. A Quieter World
3. Attack on Hazardous Water: Challenge of the 80s
4. Beyond Environmental Regulation: Industry Takes the Initiative
5. Can We Fish Again?
6. Charlie Brown Clears the Air
7. Dealing with Toxic Chemicals: A Citizen's Role
8. Gateway to Clean Air
9. Hold This Land
10. Is Your Drinking Water Safe?
11. Mandate for Clean Water
12. Modeling Photochemical Air Pollutants by Computer
13. Not Just Another Spill
14. Runoff: Land Use and Water Quality
15. Stormwater Pollution Control: A New Technology
16. The Cleaner the Water: Approaches to Sludge Management
17. Wetlands: A Case for Protection

APPENDIX E

Agencies

Alternate Energy Resources Organization
435 Stapleton Building
Billings, MT 59101
406/259-1958

Alternate Sources of Energy
Route 2
Milaca, MT 56353
612/983-6892

American Wind Energy Association
1621 Connecticut Avenue NW
Washington DC 20009

Biomass Energy Institute, Inc.
P.O. Box 129, Postal Station C
Winnipeg, MB R3M 3S7
Canada

California Office of Appropriate Technology
1530 Tenth Street
Sacramento, CA 95814

Center for Energy Policy and Research
New York Institute of Technology
Old Westbury, NY 11568
516/686-7578

Center for Manufacturing Technology
800/638-6570

Center for Renewable Resources
1001 Connecticut Avenue, 5th Floor
Washington, DC 20036
202/466-6350

Center for Solar Energy Applications
San Jose State University
Washington Square
San Jose, CA 95192
408/277-2939

Domestic Technology Institute
Box 2043
Evergreen, CO 80439

Energy Research and Information Foundation
3500 Kingman Boulevard
Des Moines, IA 50311
515/277-0968

Energy Resources Center
U.S. Department of Energy
111 Pine Street
San Francisco, CA 94111
415/556-7328

Environmental Action Coalition
235 East 49 Street
New York, NY 10019
212/929-8481

Environment Information Center
292 Madison Avenue
New York, NY 10017
212/949-9494

Environmental Study Conference
U.S. Congress
3334 House Annex 2
Washington, DC 20515
202/225-2988

Friends of the Earth, Energy Department
124 Speark Street
San Francisco, CA 94105

Hawaii Natural Energy Institute
2540 Dole Street
Honolulu, HI 96822
808/948-8890

Institute for Ecological Policies
2408 18th Street, NW
Washington, DC 20009

Institute of Energy Conversion
Energy Information Services
University of Delaware
3 Pike Creek Center
Wilmington, DE 19808
302/994-0915
302/995-7155

International Biomass Institute
1522 K Street NW, Suite 600
Washington, DC 20005
202/783-1133

International Robomation/Intelligence
2281 Las Palmas Drive
Carlsbad, CA
619/438-4424

International Solar Energy Society
P.O. Box 52
Parville
Victoria, Australia 3052

Johnson Environmental and Energy Center
University of Alabama
P.O. Box 1247
Huntsville, AL 34807
205/895-6257
800/572-7226 (Alabama only)

Mid-America Solar Energy Complex
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Bame, A. & Cummings, P. (1980). *Exploring Technology*. Worcester, MA: Davis.

What OTA Is, What OTA Does, How OTA Works. Washington, DC: Office of Technology Assessment. [Available from the GPO, Washington, DC 20510].

McCrory, D. L. & Muaghan, G. R. (1985). *Resources in technology '85*. Worcester, MA: Davis.

DeVore, P. (1980). *Technology an introduction*. Worcester, MA: Davis.

Dorf, R. C. (1974). *Technology and society*. San Francisco: Boyd and Fraser.

Hiener & Hendrix. (1980). *People create technology*. Worcester, MA: Davis.

Introduction to Technology—Group I. (1985). Albany: New York State Education Department.

Todd, R., McCrory, D. & Todd, N. (1985). *Understanding and using technology*. Worcester, MA: Davis.

The Carnegie Foundation (1983). *High schools—a report on secondary education in America*, p. 304.

Williams, Badrkham & Daggett. (1985). *Technology for tomorrow*. Cincinnati, OH: South-Western Publishing.

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